Waterbury Dam, Waterbury,VT Dam Safety Assurance Program Project Team Experience

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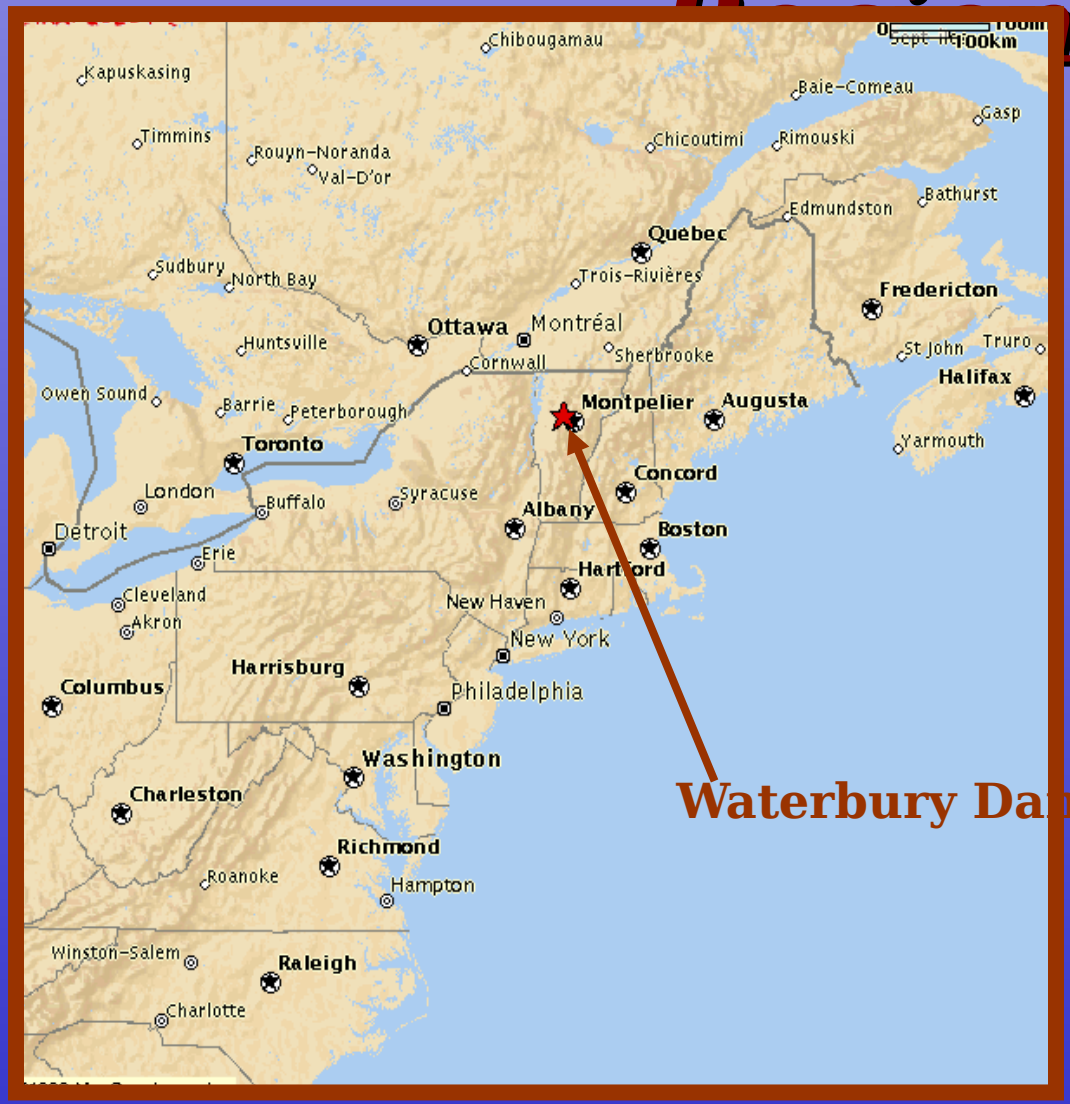
North Atlantic Division

Elements of the PDT Success Story

- Story of the Dam
  - History, Deficiencies, Solution
- Story of the Team
  - Regional, Virtual, Vertical, Collaborativ
- Lessons Learned

Waterbury Dam - Regional Map



Project Vicinity Map

Waterbury Dam is located in Winooski River Basin

Background Information:

1. Winooski River Basin Drainage Area ~ 1,200.0 mi² as it empties into Lake Champlain.

2. Little River drainage area above dam is 109.0 mi² .

3. Project was designed & built under COE supervision.
   Constructed by Civilian Conservation Corps (CCC)
   in April 1935 - October 1938.
   Operational in 1938.
   Owned, operated and maintained by Stat

Multipurpose Features

- Flood Control
  - Normal pool at el. 590’; 40’ winter drawdown
  - Average $1,000,000 annual flood damage prevented
- Hydropower
  - Added in 1953; 5.5 MW plant generates 15,000,000 kw annually
- Recreation
  - Two state parks, year-round activities,
  - Annual visitation = 75,000 user days

Waterbury Dam - Physical Features

Height of Embankment
187 feet

ew from Downstream Staging Area

View from Downstream Toe

Waterbury Dam - Physical Features

Looking East along Top of Dam

Length of Embankment

1,850 feet

Looking West along Top of Dam

Waterbury Dam - Physical Features

Emergency Spillway & Tainter Gates

Emergency Spillway ~ 161 feet
(Elevation 617.5 NGVD)

Tainter Gate Spillway - 2 gates at
(Elevation 592.0 NGVD) - 1 gate at
- All gate

Waterbury Dam - Physical Features

Hydropower Facilities

scharge thru 48” Bypass Conduit

View at Downstream Toe of Embankmen

Waterbury Dam - Construction Histor

- ***Original Construction (April 1935 - October 1938)***
  - **Built in response to 1927 flood as an emergency relief project.**
  - **Project constructed by CCC (East Barre and Wrightsville Dam also).**
  - **Waterbury Dam - $2,835,000 (July 1938).**

- ***Later Modifications to Dam with COE Involvement***
  - **1957 Modification.**
    - **Embankment was raised 3 feet.**
    - **Added Third Tainter Gate.**
  - **1985 Seepage Remediation.**
    - **Corrected terrace seepage.**
    - **Discovered and partially remediated gorge seepage.**
    - **USACE advised the State to continue to monitor the gorge area.**

Waterbury Dam

onstruction Photographs
circa 1938

Waterbury Dam

Construction Photograph near completion in 1938

Civilian Construction Corps Base Camp Area

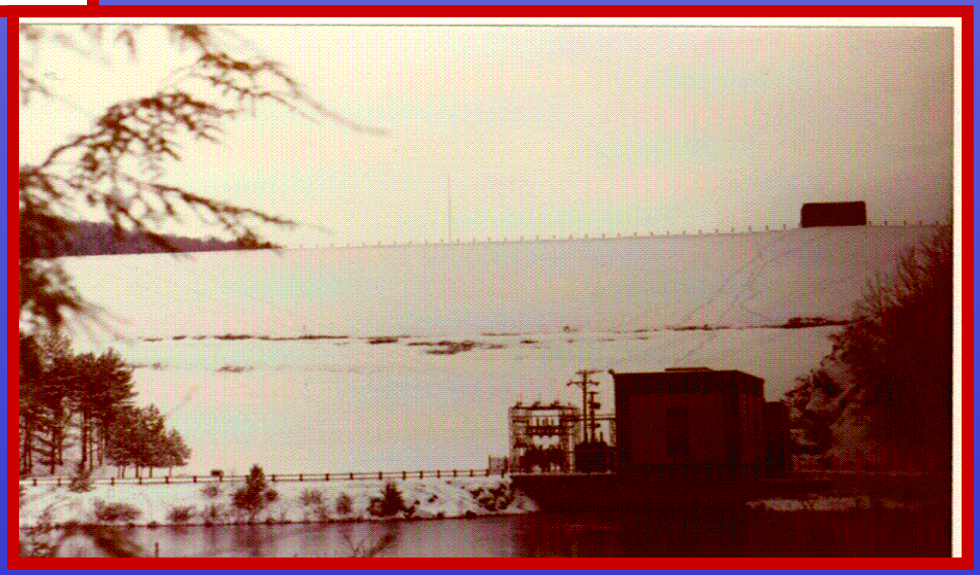
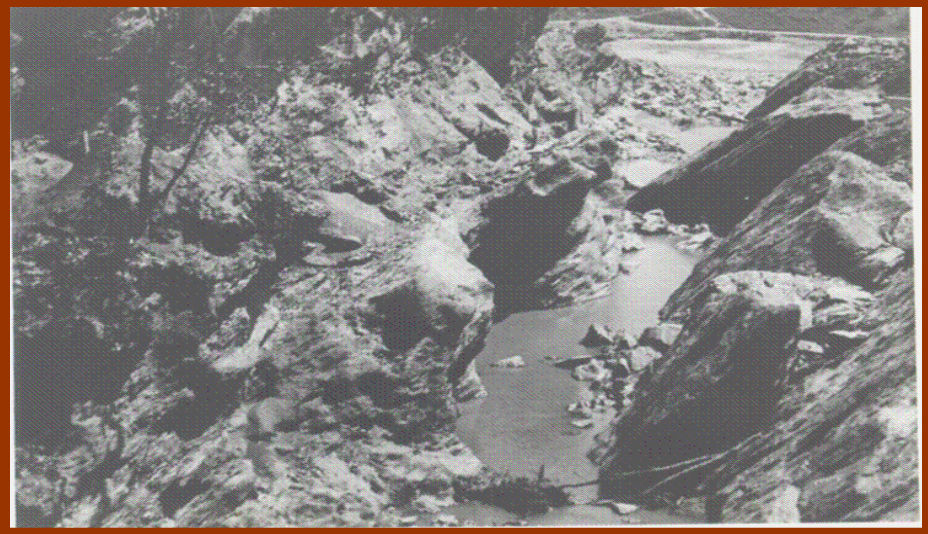


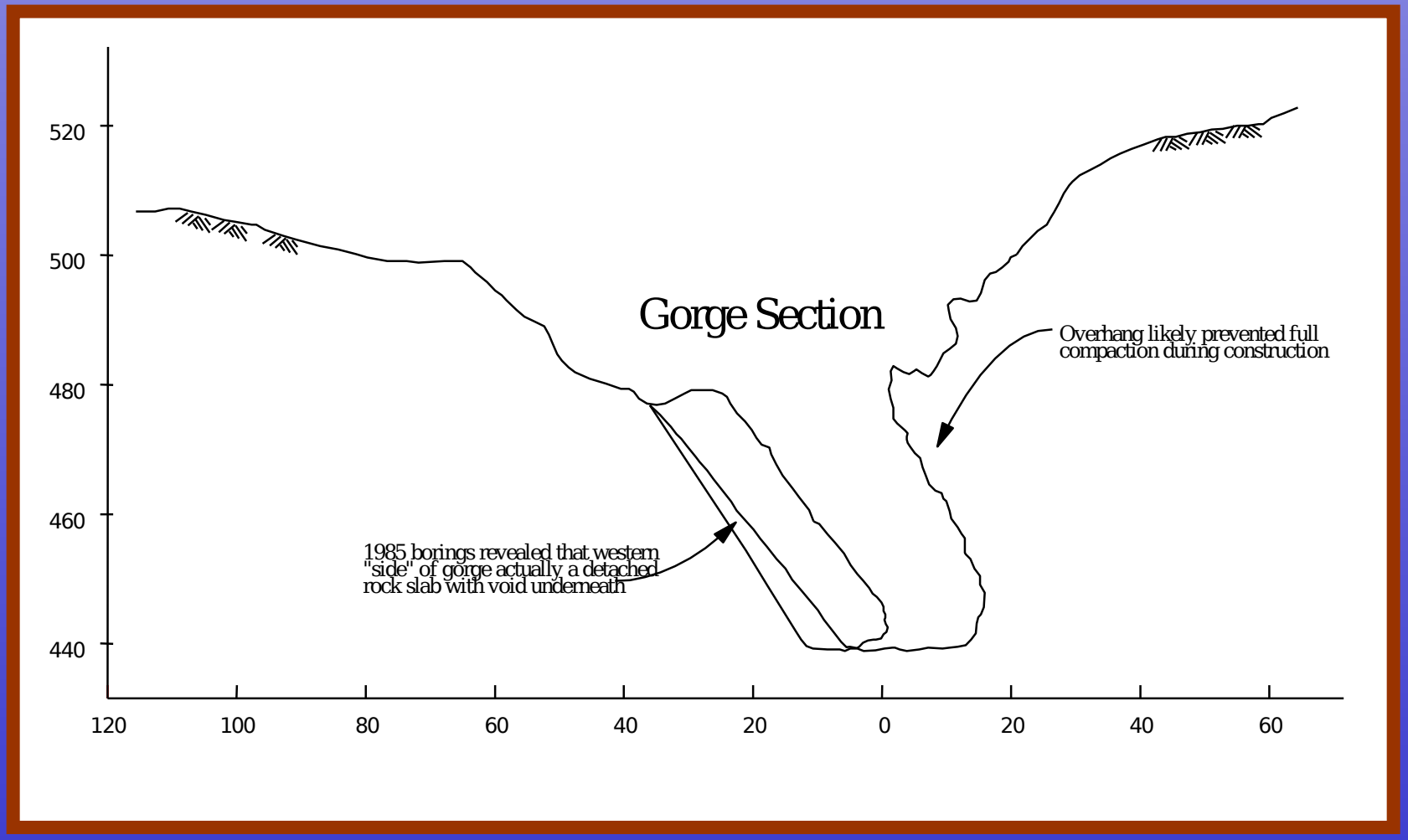
Photo of Dam in 1985

Waterbury Dam

Photographs in Gorge Area Prior to & During Initial Construction in 1935



Waterbury Dam



Cross Section through Gorge Ar

Waterbury Dam - History of Corps Involvement

- ***In 1999 the State of Vermont's A/E reviewed and documented the performance of the Waterbury Dam:***
  - **Recommended: Additional automation of instrumentation.**
  - **Recommended: <u>Construction of a filter chamber in the gorge area.</u>**
  - **Noted that: Gorge area has been an area of concern since the 1985 project and CENAB recommended this area to be monitored:**

"…the treatment provided in the gorge channel must be considered less positive than the only other alternative, a treatment which would have required a very costly deep excavation and reconstruction of a portion of the dam incorporating a series of filter zones down to bedrock."

Initial Steps & PDT Start

- New York District contacted by Vermont Dam Safety Officer
  - Joint Site Visit: NAN, NAE, NAB, NAD, HQ
- NAE had already completed 2 successful DSAP Evaluation Reports
- NAB had performed design and construction for 1957 and 1985 work

Waterbury Dam - Virtual Team

- ***Why the Need for a "Virtual Project Team"***
  - **<u>Critical need</u> related to a Public Safety Issue;**
  - **Expected short suspense and compressed schedule;**
  - **Tremendous amount of work would be done;**
  - **Scattered Expertise for DSAR existed in CENAD; and**
  - ***We NEEDED to SUCCEED !!!!!!!***

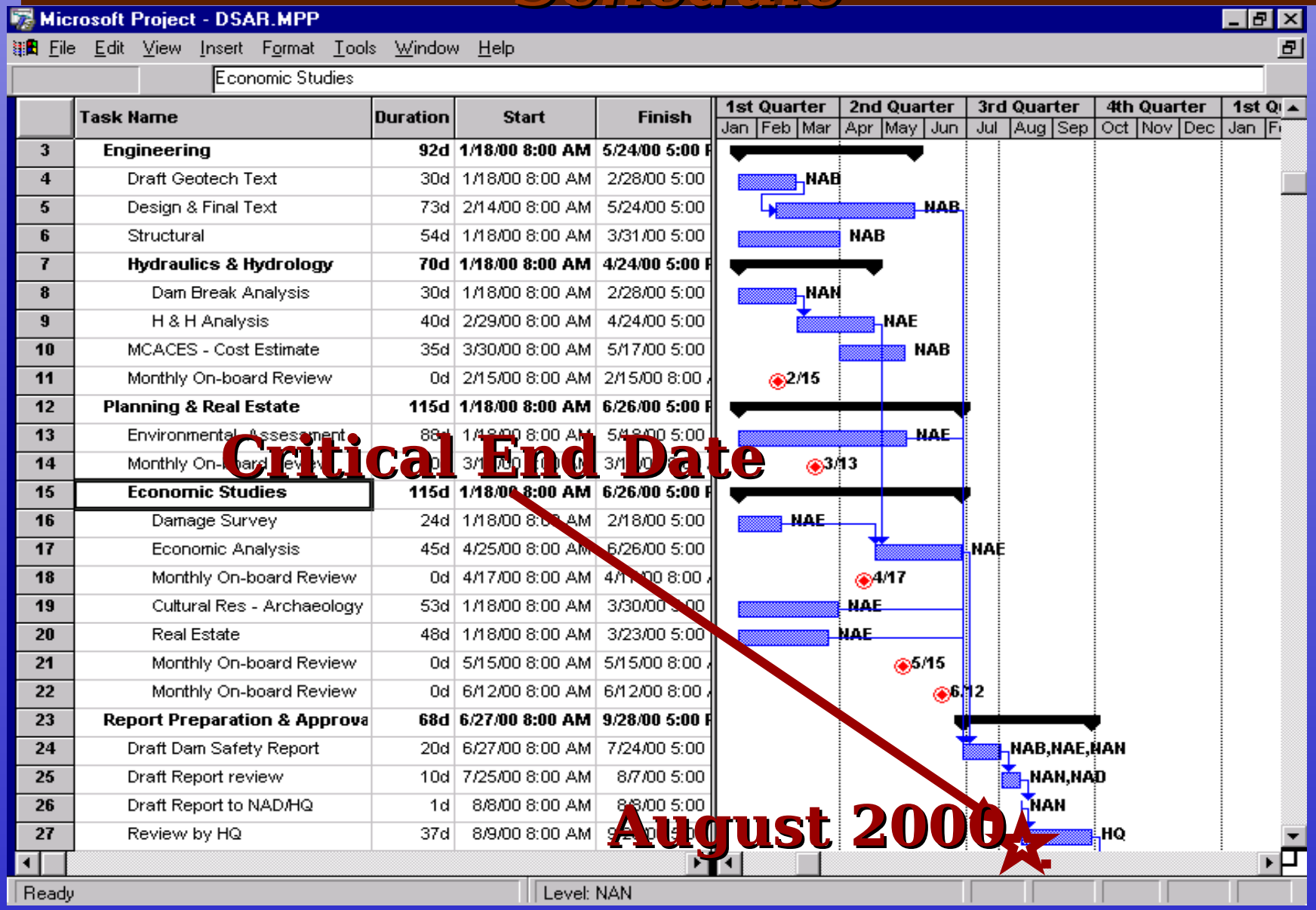
District TMs and Tasks

- New York District
  - Overall Project Management and ITR
- Baltimore District
  - Geotechnical, Structural, Design, Cost
- New England District
  - H&H/Dam Break, Economics/Loss of Life, Environmental Assessment/FONSI, Cultural, Main Report, Overall Report Prep.

Additional Team Members

- North Atlantic Division
  - Oversight, Guidance, QA, PDT/HQ Liaison
- Headquarters
  - Dam Safety, Policy Issues
- Vermont Dam Safety Officer
- Collaborative Members
  - VT Agency for Natural Resources, Fisheries, Parks and Rec., SHPO, Green Mountain Power

Waterbury Dam - DSAR Schedule


Microsoft Project - DSAR.MPP
File Edit View Insert Format Tools Window Help
Economic Studies
Task Name | Duration | Start | Finish
3 Engineering 92d 1/18/00 8:00 AM 5/24/00 5:00 P
4 Draft Geotech Text 30d 1/18/00 8:00 AM 2/28/00 5:00
5 Design & Final Text 73d 2/14/00 8:00 AM 5/24/00 5:00
6 Structural 54d 1/18/00 8:00 AM 3/31/00 5:00
7 Hydraulics & Hydrology 70d 1/18/00 8:00 AM 4/24/00 5:00 P
8 Dam Break Analysis 30d 1/18/00 8:00 AM 2/28/00 5:00
9 H & H Analysis 40d 2/29/00 8:00 AM 4/24/00 5:00
10 MCACES - Cost Estimate 35d 3/30/00 8:00 AM 5/17/00 5:00
11 Monthly On-board Review 0d 2/15/00 8:00 AM 2/15/00 8:00
12 Planning & Real Estate 115d 1/18/00 8:00 AM 6/26/00 5:00 P
13 Environmental Assessment 88d 1/18/00 8:00 AM 5/18/00 5:00
14 Monthly On-board Review 0d 3/13/00 8:00 AM 3/13/00 8:00
15 Economic Studies 115d 1/18/00 8:00 AM 6/26/00 5:00 P
16 Damage Survey 24d 1/18/00 8:00 AM 2/18/00 5:00
17 Economic Analysis 45d 4/25/00 8:00 AM 6/26/00 5:00
18 Monthly On-board Review 0d 4/17/00 8:00 AM 4/17/00 8:00
19 Cultural Res - Archaeology 53d 1/18/00 8:00 AM 3/30/00 5:00
20 Real Estate 48d 1/18/00 8:00 AM 3/23/00 5:00
21 Monthly On-board Review 0d 5/15/00 8:00 AM 5/15/00 8:00
22 Monthly On-board Review 0d 6/12/00 8:00 AM 6/12/00 8:00
23 Report Preparation & Approva 68d 6/27/00 8:00 AM 9/28/00 5:00 P
24 Draft Dam Safety Report 20d 6/27/00 8:00 AM 7/24/00 5:00
25 Draft Report review 10d 7/25/00 8:00 AM 8/7/00 5:00
26 Draft Report to NAD/HQ 1d 8/8/00 8:00 AM 8/8/00 5:00
27 Review by HQ 37d 8/9/00 8:00 AM
1st Quarter 2nd Quarter 3rd Quarter 4th Quarter 1st Q
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan
NAB
NAB
NAB
NAN
NAE
NAB
2/15
NAE
3/13
NAE
NAE
4/17
NAE
NAE
5/15
6/12
NAB,NAE,NAN
NAN,NAD
NAN
HQ
Critical End Date
August 2000
Ready
Level: NAN

Waterbury Dam - Virtual Team

- ***During the DSAR , Distinct "Phases of Study"***

  - **Basic Training - Meet on-site, meet each other, get familiar, get agreements, negotiate time & cost estimates, then go forth.**

  - **Independent Operations - With anxiety member cells are ready to embark, hence; ignite the fire, fuel the effort ($), then roll ahead.**

  - **Joint Operations - Efforts underway, tech data becoming available, meet face-to-face, *exchange data and needs*, enhance communication & coordination, initiate *write-ups for main report*.**

  - **End Line Fire Drill - Things change, react, anticipate problems, finalize documentation, get signatures for Review Certifications, think ahead, plan next phase.**

Evaluation of Alternatives

- 10 Alternatives
  - Do Nothing
  - Remove Dam
  - Replace Dam
  - Reduce Reservoir Level
  - Increase Discharge Capacity
  - Impervious Blanket
  - Downstream Filter Blanket
  - Cutoff Wall
  - George Section Replacement
  - Filter Shaft

- Evaluation Criteria
  - Technical Acceptability
  - Full Flood Protection during Construction
  - Residual Risk after Repairs
  - Total Cost
  - Benefit/Cost Ratio

Results of Study

- PDT Achieved Goal – (August 2000)
  - Completed $300,000 study in 8 months
- Recommended Plan: Filter Shaft ($26M)
  - Shaft 150’ l X 32’ w X 165’ d over Gorge
  - Multistage filter to trap material
  - Monitoring chamber in which inflow portals would allow seepage to enter
  - Collected seepage discharged through pipes

Continuation of PDT Effort

- Value Engineering Study – April 2001
  - Filter shaft excavation involves risk
- Extraction Wells and Cutoff Wall
  - Technically preferable, less risk, same effect
- PDT Remobilized
  - Revise main report, several appendices, and Environmental Assessment and FONSI
  - Addendum Report produced Nov 2001

Continuation of PDT Effort

- During Construction
  - Environmental Monitoring , Geotech, Cultural
  - Partnering Meetings
- Tainter Gate Repairs – 2005
  - Sponsor request
  - PDT mobilized again
  - Produced Addendum dated February 2005

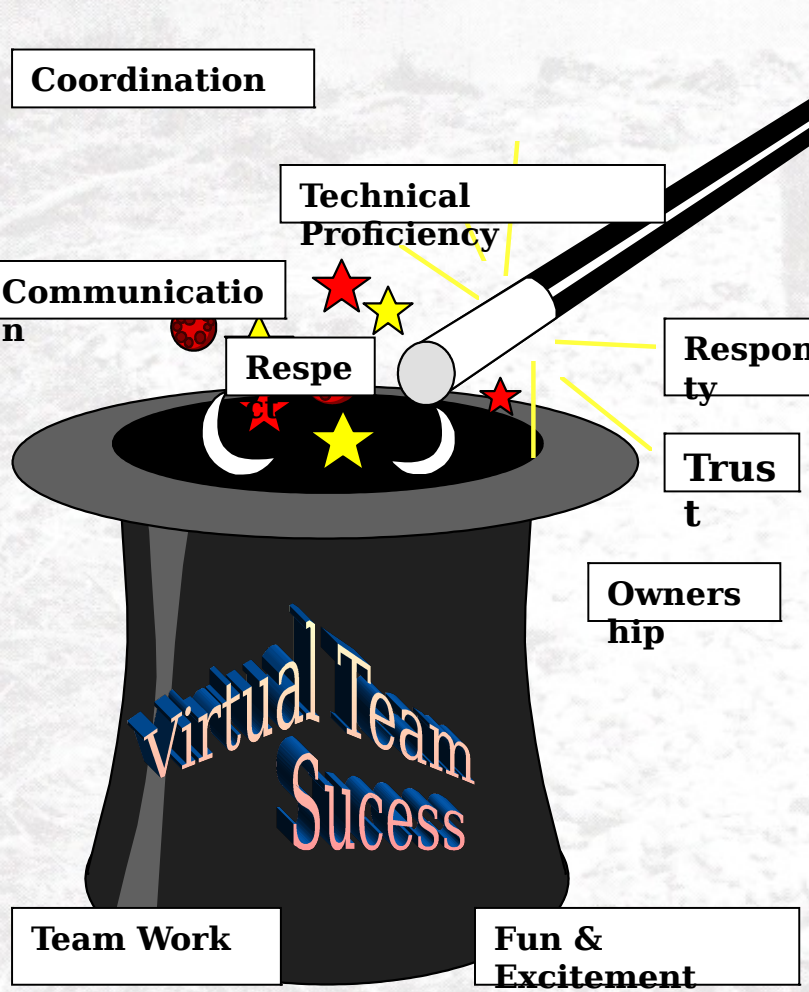
Waterbury Dam - Virtual Team

- ***For success we needed:***
  - **An individual commitment by each team member to personally develop relationships with all key counterparts at all levels.**
  - **Open communication & cooperation among study team members.**
  - **A orchestra leader to help aid the team assembly, bridge District issues, coordinate w/HQUSACE and quickly resolve stalemates.**
  - **Establishment of trust and respect for the "other District's technical and managerial" staffs.**

Waterbury Dam - Virtual Team

- ***Therefore, the Keys to using a "Virtual Team" are:***
  - **Fully Mobilizing and Energizing the Team Up, Down & Across the entire Chain-of-Command.**
  - **Quickly identify independent tasks and EXPEDITE!**
  - **Maximize the Advances made in Technology.**
  - **Careful selection of Individual Participants.**
  - **Constant awareness of the direction and progress being made.**
  - **Maintain the Momentum! Maintain the Momentum!!**

Waterbury Dam - Virtual Team



- ***It's really NOT magic***

but

- ***Success comes when planning, team work, coordination, & execution come together.***

Key Takeaway Points

- PDT Experience of 2000
  - Expedient means to a goal
  - Characterized by urgency, commitment, mutual respect and professionalism
  - No significant funding i$ $ues
  - Minimal guidance
  - Each technical discipline carefully followed
  - ER 1110-2-1155

- 2006 is a New Era
- PDT's might be forced to explore the regional and virtual concepts due to
  - Lack capability in the district; both FTE and tech
  - Funding issues
  - Regionalization emphasis
  - 2012
  - PMBP
  - New EC's

Key Takeaway Points

- Clearly define goal and schedule
- Select capable and committed tm's
- Get buy-in from each district's management
- Go vertical through division and RIT
- Go collaborative: sponsor, agencies, NGO's
- Insure adequate funding
- Establish ITR team at start of study